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Multiquart Containers--

Their Effect on Milk Packaging and Handling Costs in Selected Cooperatives

by William J. Monroe

Growth Through Agricultural Progress

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE

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U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

Joseph G. Knapp, Administrator

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising, product quality, costs, efficiency, financing, and membership.

The Service publishes the results of such studies, confers and advises with officials of farmer cooperatives, and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA Title II).

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Summary and Conclusions

Milk plant operators are constantly adjusting their business operations to changes brought about by large volume operations, intermarket competition, and a trend toward more in-store sales.

One of the factors contributing to wider distribution and increased sales in grocery stores was the advent of the multiquart container. The increased use of multiquart containers has had a tremendous impact upon the dairy industry. The new size has introduced new flexibility in competitive merchandising.

FCS made the analysis reported on in this publication to determine some of the problems associated with multiquart containers and to determine their effect upon packaging and handling costs. All operations and supplies necessary to package, handle, and store milk in glass in the plant were included in the glass packaging and handling function. Paper packaging and handling were treated in the same manner.

The study indicated the greatest opportunity to improve efficiency and reduce costs lay in these steps: First, increasing volume; second, improving layout of the plant; and third, limiting the number of products and types and sizes of containers.

Cost data were analyzed for eight cooperatives in 1958. These cooperatives ranged in size from 2,300 quarts of milk and milk products packaged a day to 58,700 quarts a day.

The average cost of packaging and handling milk in all glass containers ranged from 0.77 cent a quart to 3.24 cents a quart. Total costs for paper packaging and handling ranged from 2.35 cents a quart to 3.28 cents a quart. For purposes of this study, milk in containers smaller than quarts and products other than milk in all container sizes were not evaluated individually.

For both glass and paper containers, packaging supplies were the most important and labor the second most important components of packaging and handling cost. The third most important component in both cases was building and equipment charges.

Packaging supplies costs varied among plants because of differences in prices paid for containers and supplies and differences in breakage and losses. Cost of paper containers showed less variability among plants on a unit basis than cost of glass containers.

Labor costs can often be reduced by more efficient use of workers in the plant, particularly in larger volume plants where labor inefficiencies are hard to pinpoint. Poor organization of the plant—resulting many times from the addition to existing facilities of larger equipment or the addition to existing facilities of equipment to package milk in larger containers—appeared to lead to poor utilization of labor and space in some of the plants studied.

The study showed that there was somewhat more reduction in unit packaging

and handling costs with increased volume for the products packaged in glass than for products packaged in paper.

Cost of packaging and handling each size and type of container varied widely among the individual plants. Differences among plants in the quantity of milk packaged in each size of containers contributed to the differences in costs. Cost of packaging and handling milk was high in instances where a small volume was packaged in any individual size of container. Another major factor causing cost variations was that prices paid for the various inputs varied among the plants.

Of the several packaging and handling alternatives studied, plants with smaller volume packaging milk and milk products in quarts or smaller containers only averaged the lowest milk packaging cost. For those plants with a relatively large volume of milk packaged in gallons or half gallons, the advantage in packaging and handling costs from eliminating these multiquart containers was not as great as for plants with small volume multiquart operations.

This is emphasized by the plants F, G, and H. Plant F, which packaged milk in glass only in gallons and packaged a relatively large proportion of milk in paper in half gallons, had low operating costs. The analysis showed the advantage of both a relatively simple product mix and a large volume operation. Analyses of plants G and H showed relatively small changes in costs when sizes of containers were altered.

Firms able to sell milk in large volumes in all container sizes or able to concentrate large volumes in one container size regardless of the size of container have a real advantage. The ultimate in economy may occur when a plant is able to sell a large volume in either gallons or half gallons. To the extent that handling economies (not merchandising considerations) explain the advent of multiquart containers, plants with large volumes in multiquart containers will be able to sell milk in gallon or half-gallon containers at prices lower than milk in quart containers.

For most of the associations analyzed, any great advantage in costs of packaging and selling milk in any particular size combination of glass or paper containers would have to come from distribution costs rather than from packaging and handling.

One of the major alternatives of the plants studied for increasing efficiency and reducing costs lay in increasing volume of milk handled. Although the use of multiquart containers may be needed to maintain present volume and increase future potential volume, adding multiquart containers to existing operations can result in the short run in higher packaging and handling costs. However, if the potential increased volume can be realized, costs of packaging and handling milk may be nearly the same regardless of any particular size combination of containers.

Although most of the replies from the cooperatives surveyed—as reported earlier in Farmer Cooperative Service General Report 54, "Multiquart Containers—Their Significance in Dairy Cooperative"—stated that multiquart containers were needed to maintain sales, a careful analysis of each plant's merchandising needs must be made. This need is most urgent for plants handling relatively small volumes of milk.

Multiquart Containers--
Their Effect on Milk Packaging and Handling Costs in Selected Cooperatives

By William J. Monroe
Dairy Branch, Marketing Division

One of the most revolutionary changes occurring in the past 20 years in the dairy industry has been the widespread use of half-gallon and 1-gallon containers for milk. Use of these multiquart containers is likely to increase further for many reasons.

This increased use of multiquart containers has had a tremendous impact upon the dairy industry. New containers and new sizes have introduced new flexibility and variety into competitive methods in merchandising. This flexibility probably has had as much effect on the industry as the changes affecting costs and efficiency.

Milk plants that have not had facilities to handle multiquart containers have found it increasingly hard to maintain sales volume. They have had to make adjustments in response to the increasing competition from firms distributing milk in such containers.

In 1957 the Farmer Cooperative Service conducted a survey on the use of multiquart containers by dairy cooperatives. It was the consensus of those surveyed that the only effective method of competing was to add a multiquart operation. Seven out of eight associations studied sold milk in multiquart containers. Many of these were small volume plants. But experience shows small plants may not be able economically to justify the addition of facilities to process milk in multiquart containers.

Any competitive gains made by small volume associations as a result of the addition of multiquart containers may be offset by greater disadvantages in having a high-cost operation. Good management practices can, of course, help to maintain low costs. However, there are limitations to the adjustments that a small volume operation can make in an effort to meet the significant advantages of a well-managed, large volume operation. This is reflected in the current downward trend in the number of milk plants.

Note: Appreciation is expressed to officials of the farmer cooperatives who provided data on their plant operations; and to the Department of Economics and Sociology, Kansas State University, which also provided data for one cooperative.

Purpose and Method of Study

The purpose of this report is to describe the practices and costs of eight farmer cooperatives packaging fluid milk in multiquart containers. In addition, it analyzes the alternatives of packaging or not packaging milk in multiquart containers to determine the effect of these containers on costs of packaging and handling milk.

A further purpose of this study as reported on here is to provide a basis upon which cooperatives and other firms can make decisions concerning use of multiquart containers in order to maximize net returns to producer patrons or stockholders.

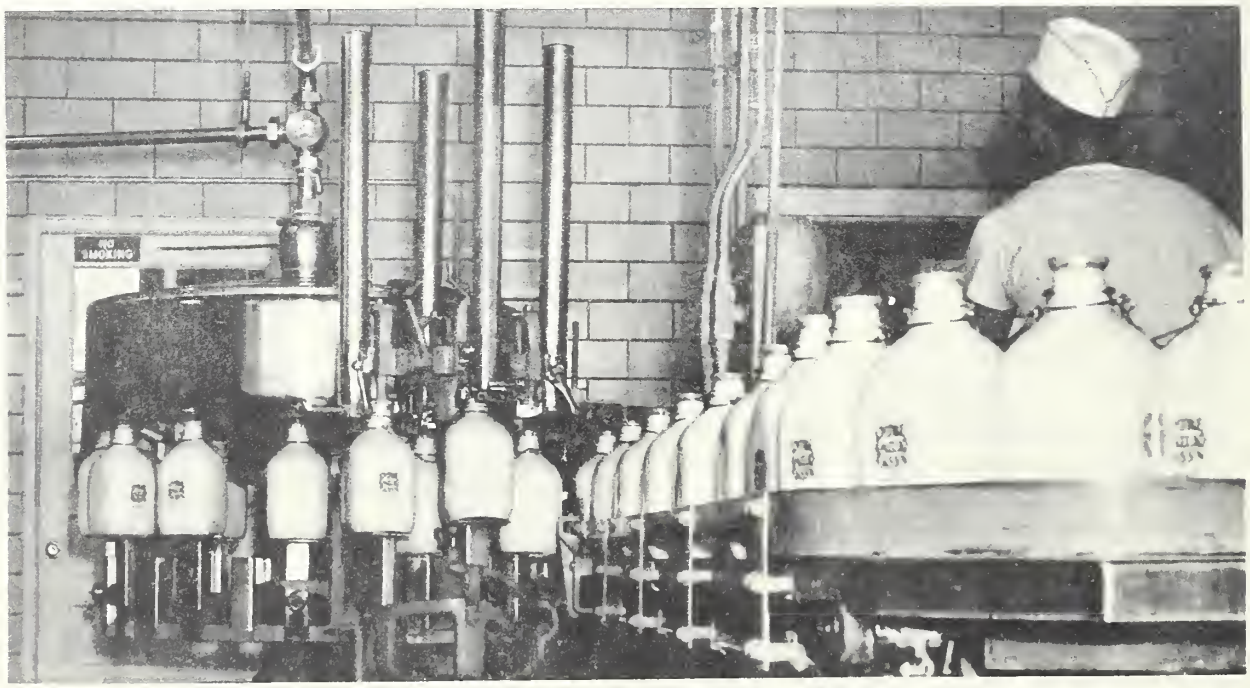
Farmer Cooperative Service published results of an earlier study in January 1959, General Report 54, entitled "Multiquart Containers — Their Significance in Dairy Cooperatives." This described and evaluated practices of fluid milk distributing cooperatives in their use of multiquart containers.

Source of Data

For this study we obtained cost data in 1958 from eight cooperatives distributing packaged milk. Three of the plants studied were located in the South Atlantic region, four in the West North Central region, and one in the East North Central region.

All cooperatives studied had one thing in common. They all processed and packaged fluid milk. Here the likeness ended. For there was a great deal of variety in the operations and processes of the associations.

Three of the associations primarily packaged and distributed fluid milk and



The increased use of multiquart containers has had a great impact upon the dairy industry.

had only small manufacturing operations incidental to milk distributing. Four of the associations were primarily manufacturing cooperatives and had packaged fluid milk operations incidental to their primary operation. One association principally sold milk to other handlers by bargaining, and also operated packaging and manufacturing facilities incidental to its primary bargaining function.

Method of Analysis

Cost information used in this study was obtained from audits, published reports, and directly from the records of the various associations. The information was placed on as comparable a basis as possible.

Observed costs under existing circumstances were used because plants producing several products operated at various proportions of capacity and seldom at the ideal level in any individual operation. Market opportunities, as well as costs, generally dictate the level of production. A special factor influencing the level of production in a farmer cooperative is the volume of milk supplied by its members. Therefore it is more realistic in determining alternative operations to approximate the operating circumstances actually found rather than the ideal circumstance.

The method of analysis in which cost centers are used to facilitate the distribution of costs to products has been used by other researchers.[1] This method, as used in this study, is now explained.

Under it, plant costs were segregated into four major divisions: Manufacturing, fluid milk processing and handling, delivery and selling, and administrative. Fluid milk processing and handling costs were further divided into six functional areas. These areas were described in terms of physical activities carried out within the plant. The six functional areas or cost centers were: Processing, empty bottle storage, bottle washing and filling, paper packaging supplies, storage, paper container filling, and cold room.

The sum of these cost centers made up the costs for the fluid milk processing operation. Processing costs included all operations performed on milk before packaging. However these costs are not discussed in this report since they were not affected by type and size of container. This report is primarily an analysis between sizes of containers of the same type, either paper or glass. In this study, milk in containers smaller than quarts and products other than milk in all container sizes were not individually evaluated.

Glass packaging and handling included all specialized operations necessary to package, handle, and store milk in glass in the plant. Major activities were receiving and storing empty bottles; bottle and case washing; and filling, casing, and storing filled bottles.

Paper packaging and handling were treated in the same manner. Major activities were warehousing of cartons, crate washing, and filling, crating, and storing filled containers.

In general, the procedure for identifying costs by centers was accomplished in one of two ways — either direct determination or allocation. For many types of expenses, the costs could be determined directly. For example, labor hours

[1] Owens, T. R. and Butz, W. T. Specifications and Costs for Processing Operations in Small Market Milk Plants. Pa. Agr. Expt. Sta. Bul. 625. August 1957.
Conner, M. C. and others. An Economic Analysis of Model Plants for Pasteurizing and Bottling Milk. Va. Agr. Expt. Sta. Bul. 484. June 1957.

could be determined according to the center in which work was performed. Electricity cost was allocated according to kilowatt hours used in the various centers. Such use was determined from motor horsepower and estimated hours of use.

Expenditures for some items could not be charged directly to the cost centers. Among these items, the charges for equipment repairs were allocated to the packaging and handling function on the basis of investments of equipment in the function. Operating supplies such as gaskets, cleaning compounds, and brushes were allocated to the cost centers in proportion to the number of hours of operating labor in those centers. Building depreciation and equipment depreciation were allocated in proportion to the investment in building area and the equipment associated with the center. Building investment was allocated to the centers according to the square feet of floor space devoted to the function of that center.

Plant costs for each of the six functional areas or cost centers were allocated among the products using the center. In the bottle washing and filling center and in the paper filling center, costs were allocated on the basis of the amount of time each package spent in the center. Thus, if half pints were filled at the same rate as quarts, they incurred the same charge as quarts in the filling centers. In the empty bottle storage center, paper packaging supplies storage center, and the cold room center, costs were allocated to a product on the basis of the space it occupied in the center.

Allocating costs to a product on the basis of the time each package spent in the center and on the basis of space occupied by the product has certain limitations. Although these limitations exist, this method has been used and is acceptable to other researchers.

Packaging supplies cost was charged directly to the product. This cost for a product in a glass container includes the cost a trip for the bottle and case and the cost of a cap. The packaging supplies cost for a product in paper containers includes container plus container supplies such as wire and glue plus the cost a trip for the case.

For ease of presentation, the cost centers pertaining to glass were combined to represent a major function, glass packaging and handling. The cost centers pertaining to paper were combined to represent a major function, paper packaging and handling.

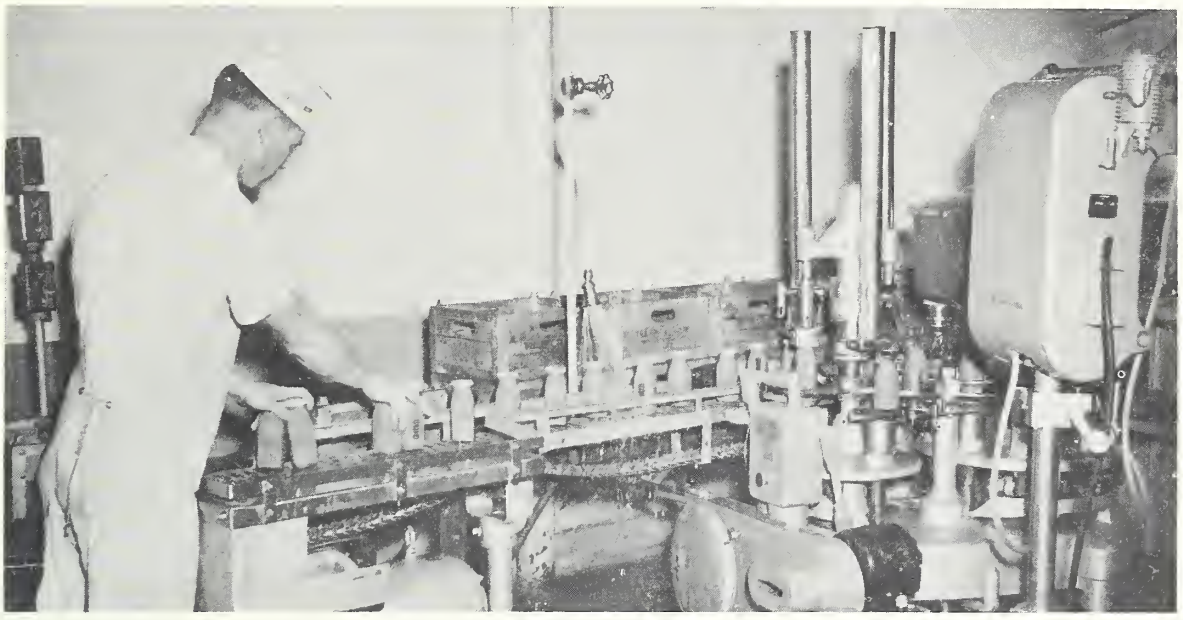
Since the major purpose of the study was to examine the specific effects of different sizes and types of containers on overall operations and costs, little effort was made to allocate total processing costs into the various functions or to the various products. Types or sizes of containers have little or no effect upon such operating costs as receiving, pasteurizing, and homogenizing. Almost the entire effect on costs of different sizes and types of containers is in either the paper or glass handling function.

The study included a range in volume of plants from about 2,300 quarts to 58,700 quarts daily. The range in volume packaged in glass was from 1,000 to 27,000 quarts daily. The range in volume packaged in paper was from 5,800 quarts to 45,400 quarts daily.

Average Costs

Total glass and paper packaging and handling plant costs were obtained by totaling the unit costs incurred in each center. Total glass and paper packaging supplies costs were obtained by totaling unit costs for each container. Total plant costs plus total packaging supplies costs made up the total costs.

sizes or capacities. Also it was expected that unit costs of packaging and handling milk in various sizes of glass or paper containers would vary between plants of different sizes. In the case of the plants studied, the larger plants generally had lower levels of unit costs for either glass or paper containers.



Costs of packaging and handling were greater in plants with small volumes such as the one above than in plants with large volume operations.

Average total costs for all glass packaging and handling ranged from 0.77 cent a quart in plant F to 3.24 cents a quart in plant H (table 1). These extremes represent completely different operations. Average total costs for all paper packaging and handling ranged from 2.35 cents a quart in plant F to 3.28 cents a quart in plant B (table 2).

Total unit cost for packaging and handling milk in all types and sizes of containers varied between plants of different

The analysis in this study was not designed for comparisons between glass and paper handling operations.

Other studies have analyzed relative costs of using glass and paper containers. Conner and others wrote in their bulletin that modification of a model plant with a daily volume of about 15,000 quarts from all glass to all paper increased daily costs 41 percent.[2] They further stated, however, that there may be offsetting gains for paper. In a study of paper

[2]Conner, M. C., and others. An Economic Analysis of Model Plants for Pasteurizing and Bottling Milk. Va. Agr. Expt. Sta. Bul. 484, June 1957.

Table 1.—*Average cost per quart of packaging and handling milk and milk products in all glass containers, by major cost items, eight cooperatives, 1957*

Plant[1]	Average daily volume packaged	Cost item													
		Labor[2]		Packaging supplies		Operating supplies		Utilities		Building and equipment		General expense[3]		Total	
	Quarts	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent
D	993	0.52	23.87	0.84	38.73	0.12	5.74	0.07	3.18	0.46	21.06	0.16	7.42	2.17	100
A	2,281	.79	31.66	.97	38.69	.13	5.16	.02	.77	.35	14.08	.24	9.64	2.50	100
B	2,572	.84	39.07	.57	26.17	.08	3.86	.25	11.73	.29	13.28	.13	5.89	2.17	100
E	4,533	.56	29.50	.71	37.58	.13	7.04	.08	3.96	.22	11.71	.19	10.21	1.88	100
C	4,873	.58	41.62	.45	32.29	.10	7.27	.05	3.42	.16	11.18	.06	4.22	1.40	100
F	9,774	.20	25.57	.37	48.40	.06	7.44	.02	2.34	.08	10.96	.04	5.29	.77	100
H	13,255	.83	25.70	1.34	41.62	.04	1.23	.12	3.72	.78	24.06	.12	3.67	3.24	100
G	27,483	.28	25.82	.58	53.44	.04	3.56	.02	1.60	.08	7.72	.08	7.86	1.09	100
Average		.57	30.26	.73	38.35	.09	4.65	.08	4.08	.30	15.91	.13	6.75	1.90	100

[1]The plants are coded on the basis of total volume of milk processed and packaged.
[2]Wages and salaries.
[3]Payroll taxes, other taxes, insurance, and interest.

packaging of milk in Wisconsin, Cook suggested that although plant and package costs of paper are slightly greater, many plants go into paper packaging for such other reasons as meeting competition, lowering distribution costs, and extending distribution areas.[3]

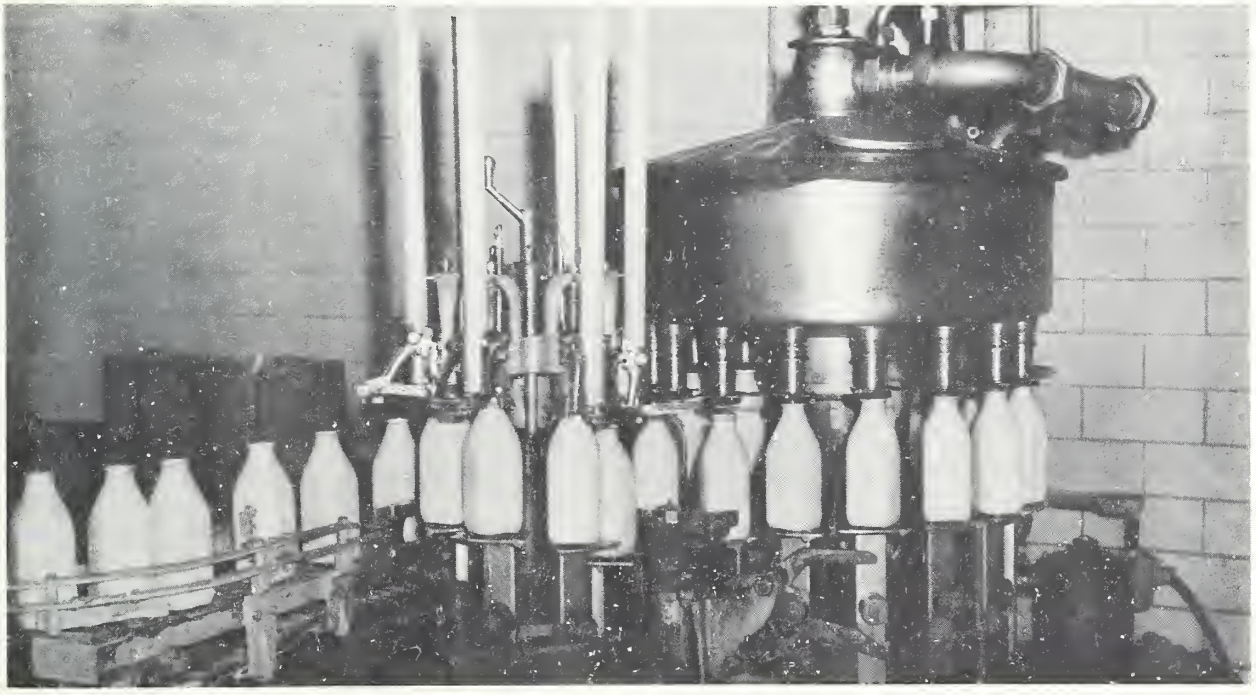
Purcell and others in a study of costs of processing and distributing milk in the South stated that among 17 plants studied, 3 plants had a higher glass washing and packaging cost than for paper packaging; in 4 plants the cost was about the same; and in 8 plants the cost of washing and packaging glass was much lower than that of packaging paper containers.[4]

Glass Packaging and Handling Cost

Average costs a quart for glass packaging and handling for each of the eight plants are shown in the "Total" column of table 1. Other columns of table 1 show the amount of the major cost items allocated to the glass packaging and handling function and the proportion that the cost item is of the total.

As components of the glass handling costs, packaging supplies were the most important and labor (wages and salaries) was the second most important. Packaging supplies on the average represented 38 percent of the cost of glass handling, labor 30 percent, supplies 5 percent, building and equipment 16 percent, and general plant expenses (payroll taxes, other taxes, insurance and interest) 7 percent.

Packaging supplies cost varied considerably among plants. This cost varied from 0.37 cent a quart in plant F to 1.34



Containers were the most important component of glass packaging and handling costs.

[3]Cook, Hugh L. Paper Packaging Milk in Wisconsin: Its Part In Expanding Distribution Areas. Wis. Agr. Expt. Sta. Res. Bul. 179, August 1955.
[4]Purcell, J. C. and Penny, N. M. Cost of Processing and Distributing Milk in the South. So. Coop. Ser. Bul. 45. Ga. Agr. Expt. Sta., June 1955.

cents a quart in plant H. Apparently there was considerable opportunity for reducing cost of packaging supplies in some plants. For example, plants varied in bottle trippage (number of trips bottle makes) and in bottle losses.

Part of the variation in packaging supplies cost shown in table 1 was due to different proportions of the milk packaged in different sizes of glass containers. In those plants that had a relatively large proportion of milk going into half-pint containers, packaging supplies cost, when measured on a quart basis, was somewhat higher than in those plants which packaged a relatively large volume in half-gallon containers. This was revealed particularly by the packaging supplies cost per quart of milk packaged and handled in plant H, which packaged nearly 61 percent of its milk in glass in half pints.

Plants varied considerably in their labor cost a quart in the glass handling portion of their operations. Labor cost ranged from 0.20 cent a quart in plant F to 0.84 cent a quart in plant B. In addition to differences in wage rates, part of the variation appeared due to differences in labor efficiency, and the ability of larger plants to use workers in a single specialized operation. The addition of multiquart facilities to existing facilities in some of the plants studied resulted in poor plant layout and poor product movement and thus increased labor requirements. Adding another container to some extent made several less efficient small operations out of a large, efficient operation.

In other plants a large volume of milk was being packaged in multiquart containers. These large volume operations made possible the efficient use of labor.

Building and equipment costs were the third largest component of the glass packaging and handling costs. These building and equipment costs varied considerably. They ranged from 0.08 cent a quart in plants F and G to 0.78 cent a quart in plant H. Variation in building and equipment costs was due to differences in investment in building and equipment and to differences in depreciation rates. In addition, buildings and equipment used by some cooperatives were rather old and were completely depreciated. Also building and equipment costs are fixed costs. Therefore, the volume of products handled affects this unit cost. The actual investment in buildings and in equipment and the depreciation rates used by each firm were used in determining this cost.

Part of the variation in building and equipment costs was due to differences among plants in amount of space and the types of equipment used for the glass filling and handling operations. Multiplication of bottle sizes not only increased total space and equipment requirements but also increased requirements per quart of milk handled. However, adding multiquart glass containers did not greatly increase building or equipment requirements for the plants that filled all sizes of containers on the same machine. All plants did not fill all sizes of containers on the same machine.

Operating supplies and utilities were relatively small parts of the total glass packaging and handling cost.

Cost of operating supplies for a quart of milk packaged and handled in glass ranged from 0.04 cent a quart in plants G and H to 0.13 cent a quart in plants A and E.

Utilities cost ranged from 0.02 cent a quart in plants A, F, and G to 0.25 cent a quart in plant B. The average for the eight plants was 0.08 cent a quart. Variation in utility cost resulted from

differences in rates and use of electricity and differences in demand factors used by power companies in compiling charges. Size of containers and multiplication of containers did not appear to affect utilities costs perceptibly.

Paper Packaging and Handling Costs

Average packaging and handling costs for a quart of milk handled in paper for each of the seven associations are shown in table 2. Association A did not package milk in paper. Both total volume put in paper by each cooperative and the proportions put in each size of container affected the average cost of the cooperative.

Data in table 2 also show the amount of the major cost items allocated to the paper packaging and handling function and the proportion that the cost item is of the total. Cost of packaging supplies was the most important component of the paper packaging and handling cost. Labor was the second largest component. Packaging supplies represented on the average 70 percent of the cost of paper handling, labor 13 percent, and building and equipment 12 percent.

Packaging supplies ranged from 1.64 cents a quart in plant F to 2.35 cents a quart of milk packaged in paper in plant G. The average cost a quart for the seven plants was 1.96 cents.

The variation in cost of packaging supplies was primarily due to differences between the seven plants in prices paid for containers, and in the proportion of milk and the number of products packaged in various sizes of containers.

Containers are subject to substantial discounts when purchased in large volumes. The variation due to differences in proportion of milk and number of products packaged in various sizes of containers results from the fact that eight one-half pint containers cost more than two 1-quart containers, which in turn cost more than one half-gallon container. In addition, the variation reflects the high cost of paper containers when purchased in small quantities for low volume specialty products.

Some of the variation in the packaging supplies cost appeared to be the result of differences in wastage of containers. This variation appeared small compared with the variation due to differences in prices of container blanks. Much of this difference was due to different quantities of the various sizes of containers used. That is, with other factors being equal, a plant that packaged a large volume in half pints would have a higher container cost per quart of milk packaged than a plant which packaged a large volume in quarts. In addition, some plants used preformed containers while others used containers which were formed and filled on the machine.

Building and equipment costs were the third most important component of paper packaging and handling cost. The major part of these costs were composed of machine rentals for paper forming and packaging machines. Building and equipment costs ranged from 0.25 cent a quart of milk handled in plant B to 0.44 cent a quart in plant E. The average for the seven plants was 0.36 cent a quart.

Much of this variation was due to differences between plants in the proportion of milk put into smaller containers and to differences in production rental paid for the paper packages.

Table 2.—*Average cost per quart of packaging and handling milk and milk products in all paper containers, by major cost items, eight cooperatives, 1957*

Plant[1]	Average daily volume packaged	Cost item													
		Labor[2]		Packaging supplies		Operating supplies		Utilities		Building and equipment		General expense[3]		Total	
	Quarts	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent
C	5,670	0.41	15.64	1.78	67.99	0.03	1.00	0.02	0.82	0.34	13.20	0.04	1.35	2.63	100
B	5,671	.52	15.82	2.30	69.92	.07	2.15	.11	3.44	.25	7.64	.03	1.03	3.28	100
D	9,772	.52	15.94	2.13	65.81	.13	4.08	.02	.53	.39	12.00	.05	1.64	3.24	100
E	10,258	.37	13.60	1.76	64.36	.09	3.40	.01	.27	.44	16.02	.06	2.35	2.73	100
F	13,247	.34	14.52	1.64	69.54	.08	3.15	.01	.23	.27	11.54	.02	1.02	2.35	100
G	19,162	.22	7.36	2.35	77.17	.02	.70	.01	.21	.40	13.33	.04	1.23	3.04	100
H	45,441	.27	11.35	1.78	69.12	.01	.52	.05	2.09	.38	14.97	.05	1.95	2.53	100
Average		.38	13.31	1.96	69.66	.06	2.14	.03	1.12	.36	12.27	.04	1.50	2.83	100

[1]Association A did not package milk in paper containers.
[2]Wages and salaries.
[3]Payroll taxes, other taxes, insurance, and interest.

Containers Analyzed Separately

Procedures used in this study provided a method of measuring the expenses incurred in the packaging and handling department for milk and other products packaged in the various sizes of containers. In this study gallons, half gallons, and quarts were evaluated.

Each size package of product was charged with a share of each of the costs making up the packaging and handling operation. The sum of these costs for each package represented the filling and handling cost a container. Table 3 summarizes packaging and handling cost per unit for glass gallons, half gallons, and quarts at the plants studied.

The three factors causing differences in costs were:

1. Differences in quantity packaged in each size container. The cost of packaging and handling milk was high in instances where a small volume was packaged in any individual size of container.

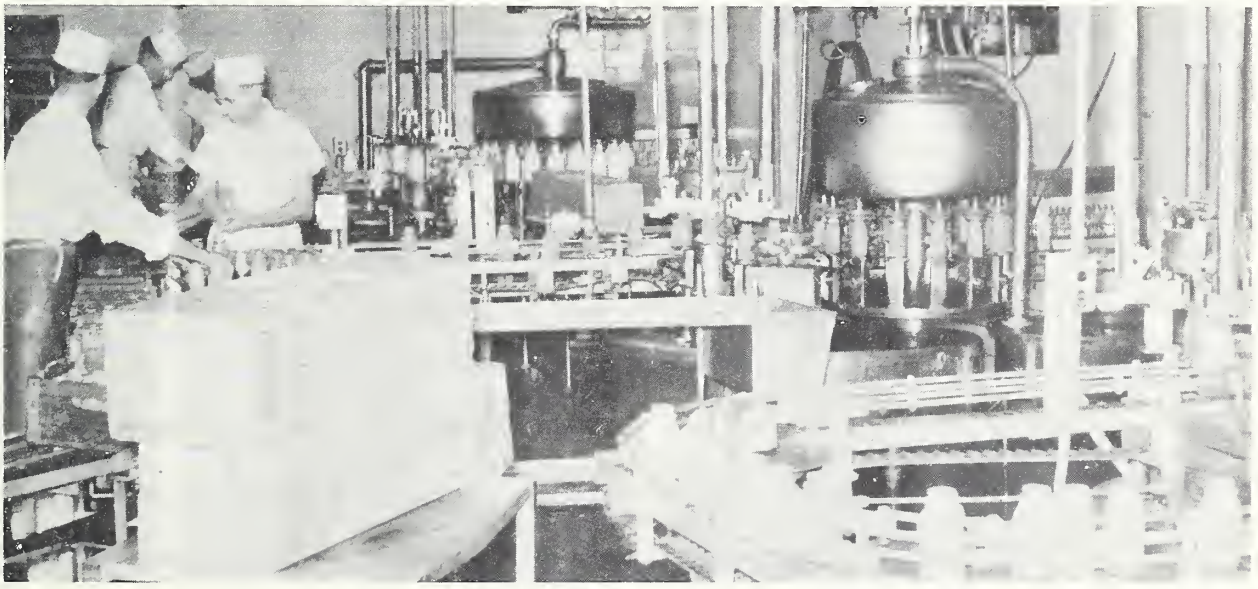
2. Method of packaging. The cost of packaging and handling milk was high where hand operated or semi-automatic equipment was used in the packaging operation.

3. Prices paid for various inputs. Labor rates as well as prices paid for packaging supplies and operating supplies varied between plants.

Glass Packaging and Handling Cost

Table 3 shows average unit glass packaging and handling cost, representing the cost of containers, washing and packaging them, placing them in cases, and stacking cases in the cooler. The table gives this cost for milk in gallons, half gallons, and quarts.

Glass packaging and handling costs for different container sizes were not proportional to the capacity of the container. For example, in plant D the cost



Proper layout of a plant such as the one shown above helps to keep costs down.

Table 3.—*Unit glass packaging and handling cost per quart, by containers, eight cooperatives, 1957*

Gallon containers			Half-gallon containers			Quart containers		
Plant	Units packaged daily	Cost per quart	Plant	Units packaged daily	Cost per quart	Plant	Units packaged daily	Cost per quart
		Cents			Cents			Cents
D	68	1.71	B	83	2.78	A	221	1.94
B	210	1.65	A	125	2.02	D	268	2.14
E	217	1.52	E	184	2.07	B	1,359	1.99
A	309	1.60	D	208	1.75	H	1,866	1.70
F	2,409	.76	H	1,517	1.33	E	2,316	1.44
Average	643	1.45	G	4,738	.81	C	4,079	1.09
			Average	1,143	1.79	G	9,824	.88
						Average	2,847	1.60

per quart for packaging and handling milk in quarts was 2.14 cents compared to 1.75 cents a quart in half gallons and 1.71 cents a quart in gallons.

The effect of volume on total glass packaging and handling costs for milk packaged in gallons, half gallons, and quarts by these plants is shown in this table.

In most cases, glass packaging and handling cost declined as the scale of operation expanded from the smallest plant A to the largest plant H. This pattern of decreasing cost followed for all sizes of glass containers. Within the volume range of the plants studied, unit cost declined more for some container sizes than for others.

Data in table 3 show the advantages of large volume in gaining minimum glass packaging costs. The relationships did not show that the larger plants always had lower costs. Rather, they indicated that lower costs are possible in the larger plants when equally well organized and operated.

Gallon Glass Containers

Packaging and handling cost for milk in glass gallon containers generally decreased with increasing volume for four of the five associations over the range of the plants studied. Packaging and handling cost ranged from 0.76 cent a quart for plant F with a daily output of 2,409 gallon containers to 1.71 cents a quart for plant D with an output of 68 gallon containers a day (table 3). The average for the five plants was 1.45 cents a quart.

Half-Gallon Glass Containers

Packaging and handling cost for milk packaged in half-gallon glass containers decreased with increased volume for five of six associations. Cost ranged from 0.81 cent a quart for plant G with a daily output of 4,738 half gallon containers to 2.78 cents a quart for plant B with a

daily output of 83 half-gallon containers (table 3). The average for the six plants was 1.79 cents a quart.

Quart Glass Containers

Packaging and handling cost for milk in quart glass containers ranged from 0.88 cent a quart for plant G with a daily output of 9,824 quart containers to 2.14 cents a quart for plant D with a daily output of 268 quart containers (table 3). The average for the seven plants was 1.60 cents a quart.

Packaging and handling cost for glass quarts decreased with increased volume for six of the seven associations but this decrease was not as great as for gallons or half gallons within the volume range existing in the plants studied.

Paper Packaging and Handling Cost

Average unit paper packaging and handling cost for each plant, representing the sum of the cost of containers, packaging them and placing them in cases and stacking the cases in the cooler, is shown in table 4. The table gives the paper packaging and handling cost for milk in half gallons, half-gallon twin-paks, and quarts.

Like glass, paper packaging and handling costs for different sizes of units are not proportional to the volume of the unit. Paper packaging and handling cost on a quart basis as related to the applicable volume is shown in table 4 for half gallons and quarts. The pattern of decreasing unit cost with enlarged volume was apparent for both half gallons and quarts.

Half-Gallon Paper Containers

Packaging and handling cost for paper half gallons decreased with large volumes for the associations studied. Packaging and handling cost for paper half gallons ranged from 1.91 cents a quart for plant H with an average daily output of 6,889 half-gallon containers to 2.95

Table 4.—*Unit paper packaging and handling cost per quart, by containers, six cooperatives, 1957*

Half-gallon containers			Quart containers		
Plant	Units packaged daily	Cost per quart	Plant	Units packaged daily	Cost per quart
		Cents			Cents
C	477	2.95	B	1,173	2.62
D	1,256	2.78	F	1,322	2.60
B	1,496	2.82	E	2,198	2.55
E	3,157	2.11	D	3,533	2.49
F	4,997	2.04	C	3,604	2.21
H	6,889	1.91	G	3,883	2.38
Average	3,045	2.44	H	11,413	1.82
			Average	3,875	2.38

cents a quart for plant C with an average daily output of 477 half-gallon containers (table 4). The average cost for the six associations was 2.44 cents a quart.

Quart Paper Containers

Packaging and handling cost for paper quarts ranged from 1.82 cents a quart for plant H with an average daily output of 11,413 quart containers to 2.62 cents a quart for plant B with an average daily output of 1,173 quart containers (table 4). The average of the seven associations was 2.38 cents a quart.

The decrease in packaging and handling cost when volume increased was greater for milk in paper half-gallon containers than for milk in paper quart containers. The reduced per-unit packaging and handling cost of paper containers associated with large volume was due largely to the reduced cost of containers and the increased rate of output for the larger machines.

Effect of Multiquart Containers on Packaging and Handling Costs

For the purposes of this study, nine alternatives of packaging or not packaging milk in multiquart containers were analyzed to determine the effect of these containers on cost of packaging and handling milk. These alternatives were analyzed as modifications of the actual operations and their cost within an association.

In other words, the analysis showed what the effect on cost would be if an association changed the ratio of gallon, half gallon, or quart sizes it used originally for packaging.

Within an association, alternatives for packaging milk and milk products in glass were analyzed separately from those for packaging in paper containers.

Of the nine alternative container combinations analyzed in this section, five were for packaging milk in glass containers and four for packaging milk in paper containers. In the remaining portions of this report, the alternatives will be referred to by the following numbers:

Glass alternatives:

1. To package milk in glass gallons, half gallons, quarts, pints, and half pints.

2. To package milk in glass gallons, quarts, pints, and half pints.

3. To package milk in glass half gallons, quarts, pints, and half pints.

4. To package milk in glass quarts, pints, and half pints.

5. To package milk in gallon containers only.

Paper alternatives:

1. To package milk in half gallons, half gallon twinpaks, quarts, pints, and half pints.

2. To package milk in half gallons, quarts, pints, and half pints.

3. To package milk in half gallon twinpaks, quarts, pints, and half pints.

4. To package milk in quarts, pints, and half pints.

The alternatives for the plants studied of eliminating either all glass containers or all paper containers were not analyzed in this study.

Glass Alternatives

One plant that did not package milk in glass multiquart containers was not included in the glass analyses. Another association packaged milk in the gallon size only. For this association and the remaining six, the alternatives applied and analyzed were quarts and smaller containers only and quarts and smaller containers plus half gallons or gallons or both.

When a plant's operations were modified, total daily volume remained the same. That is, when a plant's operation was changed from alternative 1 (gallons, half gallons, quarts, pints and half pints) to alternative 2 (gallons, quarts, pints and half pints), the total daily output remained the same. The milk that had been packaged in half-gallon containers under alternative 1 was packaged in gallon containers under alternative 2.

Also, when a plant's operation changed from either alternative 1, 2, or 3 (half gallons, quarts, pints and half pints) to alternative 4 (quarts, pints and half pints) the total daily output remained the same. That is, the milk that had been packaged in any of the miltiquart containers was assumed to be packaged in glass quart containers under alternative 4.

This method of maintaining total daily output may not be entirely realistic, for if a plant did not offer certain containers to its customers, it would find it difficult to maintain sales volume. However, determining what the average daily sales might have been under all the various alternatives was beyond the scope of this study.

Alternative 1

Four plants were packaging and handling milk under alternative 1 (glass gallons, half gallons, quarts, pints and half pints) at the time of the study. The average cost for packaging and handling milk in glass for these plants was 2.18 cents a quart. Cost ranged from 1.89 to 2.50 cents a quart (table 5).

Alternative 2

The second alternative for packaging milk in glass containers eliminated the half-gallon container operation and packaged milk and milk products in gallon containers in addition to quarts and smaller containers. The primary difference between the original plants and the four modified plants was elimination of the equipment associated only with the half-gallon operation. Other equipment remained virtually unchanged. Since the associations studied packaged glass gallons and half gallons with the same machine, little equipment was eliminated.

Changing the gallon and half-gallon operations in alternative 1 to a gallon operation in alternative 2 resulted in modest changes in the quart cost for packaging and handling the same volume of milk. The average cost for the four associations with both gallon and half-gallon operations was about 2.18 cents a quart as compared to 2.07 cents a quart when modified to gallon containers only (table 5). This cost reduction amounted to 5 percent.

The principal items accounting for changes in expenses were equipment charges and labor and packaging supply

Table 5—*Comparison of glass packaging and handling cost per quart, for selected cooperatives having the same combination of containers, four cooperatives, 1957*

Packaging combination[1]	A		B		D		E		Average cost per quart, all associations
	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	
	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents
Original	2.50	-	2.17	-	2.17	-	1.89	-	2.18
Alternative 1	2.50	100	2.17	100	2.17	100	1.89	100	2.18
Alternative 2	2.26	90	2.08	96	2.11	97	1.82	96	2.07
Alternative 3	2.38	96	2.30	106	2.22	101	1.87	98	2.19
Alternative 4	2.21	88	2.04	94	2.18	100	1.69	89	2.03

[1]Alternative 1 - gallons, half gallons, quarts, pints, and half pints.
Alternative 2 - gallons, quarts, pints, and half pints.
Alternative 3 - half gallons, quarts, pints, and half pints.
Alternative 4 - quarts, pints, and half pints.

costs. Cost of packaging supplies decreased 0.05 cent a quart or 6 percent. Labor cost decreased on the average 0.03 cent a quart or 4 percent and building and equipment costs decreased less than 0.01 cent a quart or less than 0.5 percent. Other costs decreased on the average 0.03 cent a quart or 8 percent.

Alternative 3

The third glass packaging alternative considered and analyzed in this study was that of packaging milk and milk products in half-gallon containers in addition to quarts and smaller containers. That is, the gallon operation was eliminated instead of half gallons, as in alternative 2.

The primary difference between the original plants and the modified plants was the elimination of the equipment associated wholly with the gallon operation. Other equipment remained virtually unchanged.

Changing the gallon and half-gallon operations of the plants studied under alternative 1 to only half-gallon multiquart operations under alternative 3 resulted in a slight increase in the cost for packaging and handling the same volume of milk in glass (table 5). The average cost a quart for all milk packaged in glass for the four modified plants using alternative 3 (half gallons, quarts, pints, and half pints) was 2.19 cents a quart compared to 2.18 cents a quart for the same plants using alternate 1 (gallons, half gallons, quarts, pints and half pints).

Table 5 shows the difference in cost for the four plants (A, B, D, and E) was greater between alternatives 3 (half gallons, quarts, pints, and half pints), and 2 (gallons, quarts, pints, and half pints) than between alternatives 3 and 1 (gallons, half gallons, quarts, pints, and half pints). This increase in packaging and handling cost for alternatives 3 (half gallon, quarts, pints, and half pints) over 2 (gallons, quarts, pints, and half pints) was due primarily to increases in labor

and container costs when volumes in half gallons were increased. Labor cost increased 0.02 cent and container cost increased 0.06 cent a quart.

Glass packaging and handling cost was lower under alternative 3 (half gallon, quarts, pints, and half pints) than alternative 1 (gallons, half gallons, quarts, pints, and half pints) in two of the associations, A and E, and was higher in the other two associations, B and D. However, cost was greater under alternative 3 than alternative 2 (gallons, quarts, pints, and half pints), in all four associations. The increase ranged from 0.05 cent a quart in plant E to 0.22 cent in plant B.

The differences between plants resulted from differences in rates of packaging half gallons as compared to gallons and differences in cost a quart of half-gallon containers compared to the quart cost of gallon containers.

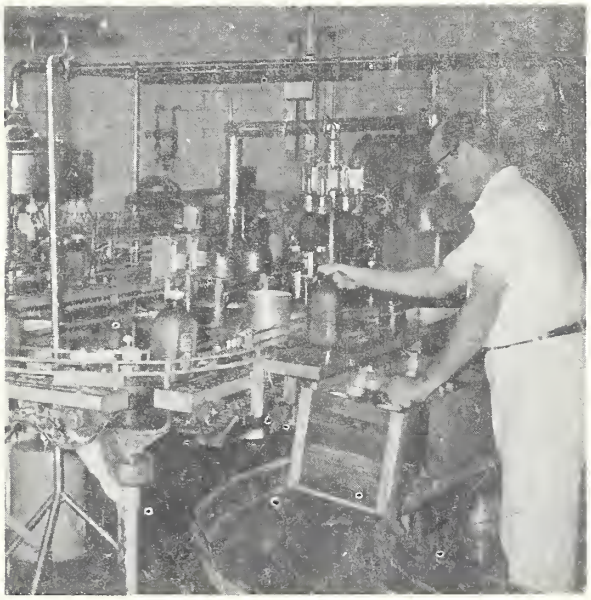
Alternative 4

The fourth glass packaging alternative considered and analyzed was packaging milk and milk products in quarts and smaller than quart containers only. All multiquarts were eliminated. Six plants were analyzed using this alternative.

The primary difference between the original plants and the modified plants was the elimination of the equipment associated with gallons and half gallons. The only exception was that the filler formerly used for multiquart containers was retained and used for filling quarts in two plants where the glass quart equipment otherwise did not have the capacity to fill the increased volume in quarts. Other equipment remained virtually unchanged.

Data in table 5 show that the average cost per quart of packaging and handling milk in glass was higher for the four associations under alternative 1 (gallons, half gallons, quarts, pints, and half pints) than under alternative 4 (quarts, pints, and half pints). These costs in plants A, B, D, and E were on the average 0.15 cent a quart higher under alternative 1 than under alternative 4. Packaging and handling cost in these same plants averaged only 0.04 cent a quart or 2 percent higher under alternative 2 (gallons, quarts, pints, and half pints) than alternative 4 (quarts, pints, and half pints). These costs in the four plants were 0.16 cent a quart higher under alternative 3 (half gallons, quarts, pints, and half pints) than under alternative 4.

Data in table 6 show that the difference in packaging and handling cost for plants A, B, D, E, G, and H was 0.12 cent a quart higher under alternative 3 (half gallons, quarts, pints, and half pints) compared to alternative 4 (quarts, pints and half pints).



One of the glass packaging and filling alternatives studied was that of using half gallons in combination with quarts and smaller containers.

Alternative 5

One of the associations studied packaged milk in gallon containers only. In addition to milk in gallons, it packaged a small quantity of flavored drinks in glass half gallons. This plant with the lowest glass packaging and handling cost a quart of any of the associations studied had the advantage of a simple and high volume glass operation.

A Comparison of All Alternatives

For those associations that packaged milk in gallon and half-gallon containers, changing from alternative 1 (gallons, half gallons, quarts, pints, and half pints), to alternative 2 (gallons, quarts, pints, and half pints) resulted in a decrease in average total cost for the glass packaging and handling function of from 2.18 to 2.07 cents a quart or 6 percent (table 5).

With alternative 3, glass packaging and handling cost increased over alternative 1 from 2.18 to 2.19 cents a quart or 0.5 percent and over alternative 2 increased 0.12 cent a quart or 6 percent. Under alternative 4, glass packaging and handling cost decreased for the four plants by an average of 0.15 cent from alternative 1, decreased 0.04 cent from alternative 2, and decreased 0.16 cent from alternative 3. When six plants were used in the comparison between alternative 4 and 3 (table 6), cost decreased 0.12 cent a quart under alternative 4.

Labor cost differed only slightly under alternatives 1, 2, and 3. This resulted because the same labor force was associated with both gallons and half gallons. When either gallon or half-gallon containers were eliminated, the difference in packaging capacity between gallons and half gallons was not great enough to change labor requirements significantly.

For the four plants using alternatives 1, 2, 3 and 4, labor cost averaged 0.10 cent a quart or 15 percent lower under alternative 4 (quarts, pints, and half pints) than alternative 1 (gallons, half gallons, quarts, pints, and half pints); 0.07 cent a quart less than alternative 2 (gallons, quarts, pints and half pints); and 0.09 cent a quart less than alternative 3 (half gallons, quarts, pints, and half pints).

For the six plants using alternatives 3 and 4, labor cost was 0.06 cent a quart lower for alternative 4. In four of the six plants, different workmen were used for packaging multiquart containers than for packaging quarts and other containers. In these instances, elimination of the multiquart containers provided a substantial saving in labor cost for the glass packaging and handling function. Labor cost also decreased as a result of eliminating a packaging machine in that less labor was needed to set up, clean, and maintain equipment when one machine did all packaging.

The study showed average packaging supplies cost for the four plants using alternatives 1, 2, 3, and 4 was 0.05 cent a quart for alternative 2 (gallons, quarts, pints, and half pints) and 0.02 cent a quart less for alternative 4 (quarts, pints, and half pints) than alternative 1 (gallons, half gallons, quarts, pints, and half pints). The cost of packaging supplies for the four plants was 0.01 cent a quart higher for alternative 3 (half gallons, quarts, pints, and half pints) than for alternative 1. The lowest packaging supplies cost a quart, 0.72 cent, for the four plants occurred with alternative 2 (gallons, quarts, pints, and half pints).

The principal differences in packaging supplies cost between the alternatives resulted from quantity discounts for larger number of packages. As larger

Table 6—*Comparison of glass packaging and handling cost per quart for selected cooperatives having the same actual or modified combination of containers, six associations, 1957*

Packaging combination[1]	A		B		D		E		F		G		H		Average cost per quart, all associations
	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	Average cost per quart	Proportion of present cost	
	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents
Original	2.50	-	2.17	-	2.17	-	1.89	-	0.77	-	1.08	-	3.23	-	1.97
Alternative 3	2.38	96	2.30	106	2.22	101	1.87	98	-	-	1.09	100	3.24	100	2.18
Alternative 4	2.21	88	2.04	94	2.18	100	1.69	89	-	-	1.05	97	3.23	99	2.06
Alternative 5	-	-	-	-	-	-	-	-	.77	100	-	-	-	-	-

[1]Alternative 3 - half gallons, quarts, pints, and half pints.
Alternative 4 - quarts, pints, and half pints.
Alternative 5 - gallons only.

quantities of one size container were purchased, cost per unit decreased. Partially offsetting this decrease was the higher cost per quart of smaller containers. The unit cost of smaller containers was less but it was not in direct proportion to capacity of the container. That is, the prices paid for a half-gallon container were not twice the prices paid for quart containers.

The study showed building and equipment costs incurred in the glass packaging and handling operation changed little on the average. The differences between alternatives 1, 2, and 3 were less than 0.01 cent a quart. The difference between alternatives 1 and 4 was 0.01 cent a quart. Building and equipment costs for alternative 1 (gallons, half gallons, quarts, pints, and half pints) were on the average 0.33 cent a quart and for alternative 4 (quarts, pints, and half pints) were 0.32 cent a quart. Alternative 4 had the lowest building and equipment cost. This lower cost for alternative 4 was accounted for by adjustments in equipment not needed for gallons and half gallons.

Another factor was the reduction in dry storage and cooler space. In actual practice, the reduction in building and equipment requirements for packaging and handling milk under various alternatives may be nonexistent. Plants may not be able or may not choose immediately to make the adjustments in equipment and space that were assumed possible in the study.

The study showed some change in operating supplies, utilities, and general expenses incurred in the glass packaging and handling operation when plants operated under different alternatives. These costs on a quart basis decreased from 0.40 to 0.37 cent when the four plants changed from alternative 1 (gallons, half gallons, quarts, pints, and half pints) to alternative 2 (gallons, quarts, pints, and half pints). The change from alternative 1 to alternative 3 (half gallons, quarts, pints, and half pints) resulted in an increase in cost for the four plants from 0.40 to 0.41 cent or 3 percent. The change from alternative 1 to alternative 4 (quarts, pints, and half pints) resulted in a decrease for the four plants of 0.03 cent a quart in the minor cost items.

Paper Alternatives

Seven of the eight associations studied packaged milk in paper containers. Six of the seven plants using paper containers packaged milk in half-gallon as well as quart and smaller size containers. One of these six plants also packaged milk in paper quarts and then attached two 1-quart containers together, a twinpak. One of the seven associations did not use the paper half-gallon container. However, it did sell twinpaks. The two associations using twinpaks used different methods of combining the 2-quart containers.

One of the associations used a paper band which was hand wrapped around the two 1-quart containers. The other association used a method which glued the two 1-quart containers together. For this latter association, the gluing operation was done automatically by an attachment on the paper packaging machine.

Of the six associations packaging milk in half-gallon containers, four used the half-gallon packaging machine most common in the industry. This machine both formed and packaged the carton. Two associations used a paper packaging machine that packaged the cartons automatically but did not form the carton. This preformed carton was previously formed by the package supplier or at

other dairy plants. The two associations purchased their preformed cartons primarily from their paper carton supplier.

Four alternative packaging and handling combinations were analyzed for paper containers. The plant's daily volume of milk in paper containers under the various alternatives was treated the same for paper as for glass. That is, the average daily volume remained the same for all alternatives.

Alternative 1

One association was using paper alternative 1 (half gallons, half-gallon twinpaks, quarts, pints, and half pints) at the time of the study. The cost a quart for packaging and handling milk in paper for this plant was 3.24 cents a quart for all milk packaged in paper (table 7). This association had the second highest paper packaging and handling cost of all plants studied.

Alternative 2

Six associations were analyzed using the alternative 2 (half gallons, quarts, pints, and half pints). Five of the six used alternative 2 as their current operation at the time of the study. The average packaging and handling cost a quart for all milk packaged in paper was 2.78 cents. Cost for the six plants using alternative 2 ranged from 2.36 cents to 3.28 cents a quart (table 8).

By modifying plant D from its original operation (alternative 1) to alternative 2, cost was reduced from 3.24 cents to 3.13 cents a quart or a reduction of 3 percent. The difference between the original operation and alternative 2 was the elimination of hand wrapping the two 1-quart containers together to form the twinpak. Also, the daily volume of milk that was packaged in twinpaks in the original operation was assumed to be packaged in half-gallon containers in alternative 2 (half gallons, quarts, pints, and half pints). The change in equipment was negligible.

The reduction in cost for plant D resulted primarily from a lower packaging supplies cost. Packaging supplies cost when plant D used alternative 1 (half

Table 7.—*Comparison of paper packaging and handling cost per quart for selected cooperatives having the same combination of containers*

Packaging plan[1]	D		G		Average cost per quart, all associations
	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	
	Cents	Percent	Cents	Percent	Cents
Original	3.24	-	3.04	-	3.14
Alternative 1	3.24	100	-	-	3.24
Alternative 3	3.12	96	3.04	100	3.08
Alternative 4	2.91	90	3.03	99	2.96

[1]Alternative 1 - half gallons, half-gallon twinpak, quarts, pints, and half pints.
Alternative 3 - half-gallon twinpak, quarts, pints, and half pints.
Alternative 4 - quarts, pints, and half pints.

Table 8—*Comparison of paper packaging and handling cost per quart for selected cooperatives having the same combination of containers, six cooperatives, 1957*[1]

Packaging plan[2]	B		C		D		E		F		H		Average cost per quart, all associations
	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	Average cost per quart	Proportion of original cost	
	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents	Percent	Cents
Original	3.28	-	2.63	-	3.24	-	2.73	-	2.35	-	2.53	-	2.80
Alternative 2	3.28	100	2.63	100	3.13	97	2.73	100	2.35	100	2.53	100	2.78
Alternative 4	2.80	85	2.42	92	2.91	90	2.60	95	2.14	91	2.46	97	2.55

[1]Association A did not package milk in paper containers.
[2]Alternative 2 - half gallon, quarts, pints, and half pints.
Alternative 4 - quarts, pints, and half pints.

gallons, half-gallon twinpak, quarts, pints, and half pints) was 2.13 cents a quart of milk packaged in paper. Under alternative 2 (half gallons, quarts, pints, and half pints) packaging supplies cost for plant C was 2.03 cents a quart or a reduction of 0.10 cent a quart. The cost a quart for half-gallon containers was less than for quart containers. In addition, the supplies needed to band together the two 1-quart containers and the handles needed for carrying the twinpak were additional costs in alternative 1. These extra supplies were eliminated in alternative 2.

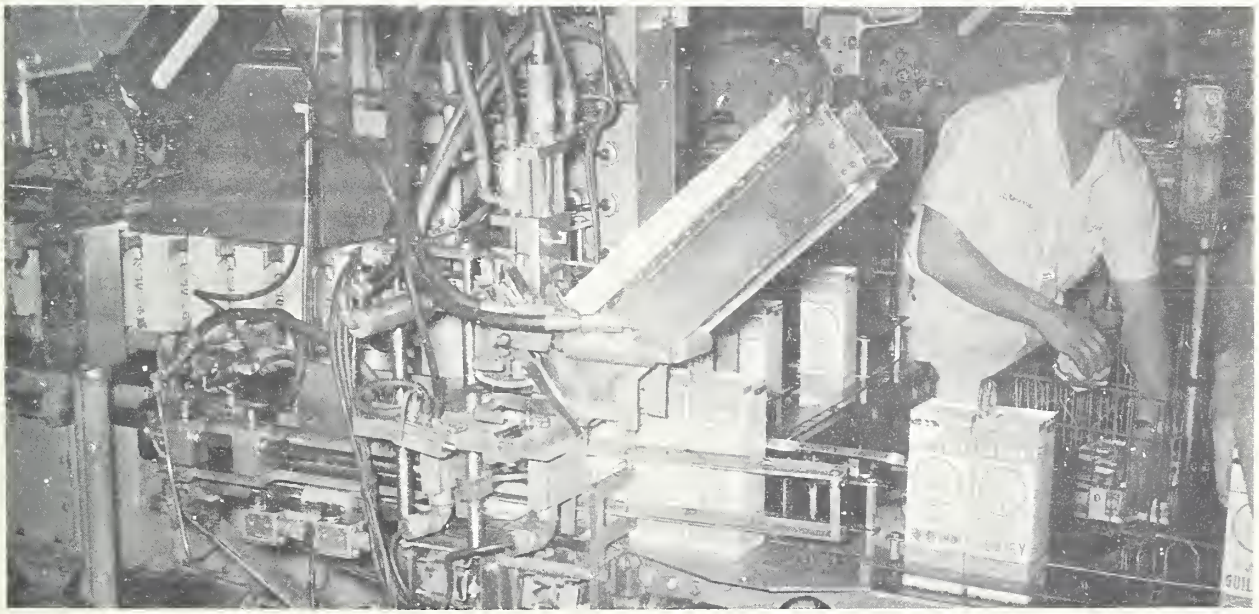
Alternative 3

Two associations were analyzed using alternative 3 (twinpaks but no half-gallon paper containers). One of the associations used alternative 3 (half-gallon twinpaks, quarts, pints, and half pints) at the time of the study and data were available to analyze this alternative for the second association.

The packaging and handling cost was nearly the same for the two associations. Plant D had a paper packaging and handling cost of 3.12 cents a quart compared to 3.04 cents a quart for plant G (table 7).

The proportions of labor, containers, building and equipment, and other costs making up the total packaging and handling cost were quite different for the two plants. Labor cost for plant D amounted to 0.45 cent a quart compared to 0.22 cent a quart for plant G. Packaging supplies cost for plant D amounted to 2.21 cents a quart compared to 2.34 cents a quart for plant G. Building and equipment costs for plant D amounted to 0.30 cent a quart compared to 0.41 cent for plant G. Other costs which included operating supplies, utilities, and general expenses amounted to 0.16 cent a quart in plant D compared to 0.07 cent a quart in plant G.

A reduction in cost of packaging and handling milk in paper resulted when the operation of plant D was modified from its original operation of alternative 1 (half gallons, half-gallon twinpaks, quarts, pints, and half pints) to alternative 3 (half-gallon twinpaks, quarts, pints and half pints). The reduction



The twinpak multiquart container was one of the paper alternatives studied in this report.

amounted to 0.12 cent a quart. The principal item accounting for the decrease was labor cost.

Labor cost for plant D was reduced from 0.52 cent a quart to 0.45 cent a quart. Labor that had been charged to half gallons in alternative 1 (half gallons, half-gallon twinpaks, quarts, pints, and half pints) was assumed to be eliminated or charged to other departments in alternative 3 (twinpaks, quarts, pints, and half pints). Additional labor inputs were required to package the increased volume in quarts which was used for twinpaks. This increase in inputs was achieved without increasing the number of workers in the quart operation. The additional volume could be packaged in quarts by extending the packaging period and by the more efficient use of labor in packaging and handling milk in quarts.

Building and equipment costs for plant D were reduced from 0.39 cent to 0.30 cent a quart for all milk packaged and handled in paper. The decrease in building and equipment costs of plant D between alternatives 1 and 3 resulted from eliminating the slightly greater per quart equipment cost for the half-gallon machine in alternative 1 compared to the equipment cost for the quart machine in alternative 3.

Alternative 4

Seven associations were analyzed using alternative 4 (quarts, pints, and half pints), although none of the associations had alternative 4 as its current operation at the time of the study. The difference between six of the original packaging plants and their modified operations was the elimination of the half-gallon packaging machine. One of the associations did not have a paper half-gallon packager. This plant was modified for alternative 4 by eliminating the gluing attachment for twinpaks on the paper quart filler.

Alternative 4 (quarts, pints, and half pints) was the lowest cost paper packaging and handling alternative for the plants studied. The average paper packaging and handling cost for the seven plants using this alternative—no half gallons or twinpaks—was 2.60 cents a quart for all milk packaged in paper. For the six plants which were analyzed using both alternatives 2 (half gallons, quarts, pints, and half pints) and 4, paper packaging and handling cost was on the average 0.23 cent a quart lower for alternative 4 than for alternative 2. Cost was reduced from 2.78 cents a quart for alternative 2 to 2.55 cents a quart for alternative 4 (table 8).

The principal items accounting for the decrease were labor and packaging supplies costs.

The decrease in labor cost per quart when alternative 4 was used was 0.08 cent a quart or 20 percent on the average. All of the six associations using alternatives 2 and 4 showed decreases in the labor cost portion of the packaging and handling operations when alternative 4 was used.

The three associations out of the six that had the lowest volume packaged in paper had decreases of 0.08, 0.12, and 0.16 cent a quart when alternative 4 was used. The other three associations had decreases in labor cost of 0.06, 0.07, and 0.03 cent a quart when alternative 4 was used, or less of a reduction. Those associations showing substantial decreases in labor cost per quart had relatively small volume half-gallon operations as well as small quart operations. Under those conditions, neither operation was efficient in the use of labor.

However, when half gallons were eliminated, the increase in volume for the quart operation resulted in a fairly efficient use of labor. The associations that had small decreases in labor costs after half gallons were eliminated had relatively large volume and efficient operations both in quarts and half gallons. In these associations, the increase in volume associated with the quart operation when half gallons were eliminated did not materially improve labor efficiency.

The greater impact of changes in sizes of containers for the small than for the large volume associations in their packaging and handling labor cost also resulted from the high proportion of the labor inputs of the small volume associations that were relatively fixed. It required about so much labor to set up, change over, and clean equipment in each operation. Once this was done, the amount of time required to package additional quantities of milk depended on the operating rate. The operating rates of packagers varied widely. Machines used by some of the smaller plants in this study took more than twice as long to package a 2-quart container as did the machine used for single quarts.

The study indicated that labor cost may be considerably greater in the paper packaging and handling operation if both quart and half-gallon paper containers are used than for quarts alone, unless there is sufficient volume in half gallons to fully utilize the additional labor needed for the half-gallon operation.

Packaging supplies cost of the six plants using alternatives 2 (half gallons, quarts, pints, and half pints) and 4 (quarts, pints, and half pints) was reduced on the average 0.10 cent a quart or 5 percent when alternative 4 (no multiquart paper containers) was used. Packaging supplies cost for the six plants using alternative 2 averaged 1.88 cents a quart compared to 1.78 cents a quart for all milk packaged in paper when alternative 4 was used. The decrease reflects the economies of purchasing paper containers in large quantities of a particular size.

Building and equipment costs on the average did not change materially when the six plants were modified from alternative 2 to alternative 4. Building and equipment costs for the six plants using alternatives 2 and 4 decreased from 0.34 cent a quart to 0.33 cent a quart.

Analysis of Individual Plants

Changing the operations of the associations to handle different containers did not affect each association in the same manner. One factor that determined the direction and magnitude of the changes in packaging and handling cost was the volume of milk packaged in total as well as the volume in each size of container. In those associations that had relatively large volume operations in gallons, and half gallons, the change to quarts did not materially change cost of packaging and handling. Another factor was the type of multiquart container.

The associations that packaged a relatively small volume in paper half gallons used a preformed carton. These containers cost more per unit than the cartons formed at the time of packaging. However, there were offsetting costs of equipment; less costly equipment was

required if preformed cartons were used. The associations that used preformed cartons had high container cost per unit in addition to higher costs in other respects.

Association A

Association A packaged the smallest volume of milk of all the plants studied. This packaging was a sideline to a manufacturing operation. This association packaged milk in glass containers only, using gallons, half gallons, quarts, pints, and half pints. The average daily volume packaged was about 2,300 quarts.

Association A ranked second (going from low to high) in volume of milk packaged in glass among all the plants studied. It packaged over half, or 54 percent, of its daily volume of milk in gallon containers, and 12, 17, and 17 percent in half gallons, quarts, and pints and half pints, respectively.

An analysis of the cost data showed that lower costs could have been achieved had this association packaged milk in quarts and smaller containers only. However, the difference between the packaging and handling costs when association A packaged milk in glass gallons, quarts, and smaller containers (alternative 2) and when A packaged milk in glass quarts and smaller containers only (alternative 4) was small, an estimated difference of 0.05 cents a quart.

For a more detailed comparison of costs for association A, using various alternatives, see appendix tables 1 and 2.

A major portion of the savings in packaging and handling cost from modified operations of association A could be achieved only if labor could be used effectively in operations other than packaging and handling. The cooperative had a small enough volume operation so that two workmen did all processing and packaging and handling of milk. Therefore, during the time packaging was being done, both workmen were occupied in the packaging and handling function. With the original method as well as with all modifications, one man operated the packager while the other workman operated the bottle washer. As both were needed during packaging, any saving in labor in association A would come from a shortened packaging schedule, and from these men working in other operations of the cooperative the remainder of the time.

Association B

Association B had both a manufacturing and a packaging operation. It packaged about 10 percent of the milk received. Ninety percent of the milk was put to other uses, primarily manufactured products.

The cooperative packaged about 8,000 quarts a day in total, 30 percent in glass and 70 percent in paper. It had the second smallest paper packaging operation of the eight associations studied, and ranked third (going from low to high) in volume of milk packaged in glass.

Association B packaged milk in glass gallons, half gallons, quarts, pints, and half pints. Fifty-three percent of the milk in glass was packaged in quarts, 33 percent in gallons, 6 percent in half gallons, and 8 percent in pints and half pints.

Association B also packaged milk in paper half gallons, quarts, pints, and half pints. It packaged over half (53 percent) of its daily volume of milk in paper in half-gallon containers, 27 percent in

quarts, 16 percent in half pints, and 4 percent in pints.

Association B had relatively high labor cost per quart of milk packaged in glass as compared to the other seven associations studied. The high labor cost was partially the result of a slightly higher hourly rate than the rates paid by some of the other associations. This, coupled with a lower output per manhour than some other associations, resulted in a high labor cost. Two associations had higher hourly labor rates than did this association. However, the output per manhour of those other two concerns was sufficiently greater than association B so their labor costs on a quart basis were less.

Association B had the next to the highest paper packaging and handling cost. It had the highest labor cost per quart of milk packaged in paper. As with the analysis of factors contributing to high labor cost in glass containers, labor cost was high in the paper packaging operation because hourly rates were high and output per manhour was low. The cooperative had a semiautomatic packager for half-gallon paper containers. The capacity of this machine was less than that of the fully automatic machine. Association B packaged about 53 percent of its milk in paper through this half-gallon machine.

Another factor that reduced the output per manhour on a quart basis for this cooperative was that it packaged about 20 percent of the milk it put in paper in half pints. The cooperative's paper packager turned out the same number of containers a minute regardless of size of container. Therefore, the time required to package a quart of milk in half pints was about four times greater than that needed to package a quart of milk in a quart container.

This cooperative had the second highest cost for paper packaging supplies, among the seven associations studied that had paper packaging operations. The cooperative paid a high price for its half-gallon containers and packaged more milk in half gallons than in all other paper containers combined. Use of half-pint packages had a similar effect. The half-pint container is expensive per quart handled and the cooperative used this size for a comparatively large volume of milk, thus requiring many half-pint containers.

An analysis of the cost data of association B showed that the lowest alternative for packaging milk in glass was achieved through use of quarts and smaller containers only. The cost of this alternative was slightly less (an estimated difference of 0.04 cents a quart) than when milk was packaged in glass gallon, quart, and smaller containers.

The lowest cost alternative for paper packaging and handling was obtained by packaging in quarts and smaller containers only. The lowest filling and handling cost for association B, assuming it was necessary to have both paper and glass, occurred when milk was packaged in glass quarts and smaller containers in combination with paper quarts and smaller containers. A small advantage in merchandising, or a small saving in delivery cost, however, would justify this cooperative in continuing to use gallon glass containers, as well.

For a more detailed comparison of costs when association B used various packaging and handling alternatives, see appendix tables 3, 4, and 5.

Association C

Association C had an average daily volume of about 10,500 quarts. It ranked

third (going from low to high) in volume of milk processed and packaged. The cooperative packaged about 4,900 quarts a day in glass containers and about 5,600 quarts a day in paper containers. It packaged milk and milk products in glass quarts, pints, and half pints, but did not package milk in glass multiquart containers. In paper, it packaged milk and milk products in half gallons, quarts, pints, and half pints.

The cooperative packaged about 46 percent of its milk in glass and 54 percent in paper. It ranked fifth (going from low to high) in volume of products packaged in glass and packaged the smallest volume of milk in paper containers of the plants studied.

The study showed that with the observed volume the alternative of packaging milk in quarts, pints, and half pints resulted in the lowest quart cost of packaging milk in paper. However, association C had not operated the half-gallon machine for a full year when the data were taken. If adding the half-gallon container to the product line later enables the association to increase sales, future paper packaging and handling cost of alternative 2 may be reduced to a level only slightly greater than the packaging and handling cost of alternative 4.

For a more detailed comparison of costs when association C used various container combinations, see appendix tables 6 and 7.

Association D

Association D had a relatively small operation (10,800 quarts a day). It packaged about 1,000 quarts a day in glass containers and about 9,800 quarts a day in paper containers. In glass, it packaged milk products in gallons, half gallons, quarts, and half pints. It packaged milk and milk products in paper half gallons, quarts, pints, and half pints. It also had a paper twinpak operation in addition to the half-gallon operation.

The cooperative ranked fourth (going from low to high) in total volume of milk packaged. It ranked lowest in volume in glass and third in paper. The glass operation was in a separate plant from the paper operation. However, there was some movement of inputs, particularly labor, between the two plants of the association.

Association D differed from the other associations in the container combination used. The glass container combination was similar to most of the other plants studied. However, this association was the only one that had a paper twinpak operation as well as a paper half-gallon single container operation.

An analysis of the packaging and handling cost data showed that the lowest cost alternative for glass was achieved when milk was packaged in gallons, quarts, and smaller containers. The lowest cost alternative for paper was obtained when milk was packaged in quarts and smaller containers. Thus, the lowest packaging and handling cost for this cooperative in either paper or glass was achieved by eliminating certain containers: Half gallons in glass, and both twinpaks and single half gallons in paper.

Costs were not determined for any association for packaging milk in only one specific multiquart container such as gallons only or half gallons only. It was assumed that market demands were such that these associations needed to provide customers with milk and milk products in quarts or smaller containers either in paper or glass.

Association D also differed from other plants in the study in its type of operation. This association processed and packaged milk in two separate plants: One for glass and one for paper. The full advantage of specialization in operations was not evident for this association because it packaged a relatively small volume in each plant. Even with specialization of operations, association D had high packaging and handling costs compared with other plants in the study. A more complete analysis of the effect of multiquart containers on packaging and handling costs of the association is shown in appendix tables 8, 9, and 10.

Association D was in the process of switching from twinpaks to regular half-gallon paper containers. This had a considerable effect upon costs of the paper packaging and handling function. Under these conditions the cost of packaging and handling milk in half gallons was relatively high. However, as volume in multiquart containers increases, it seems probable that by using regular half-gallon containers as its only paper multiquart container, association D would have lower per unit costs than if the entire multiquart volume were put in twinpaks.

The study showed that solely from the operating cost standpoint, and with its present volume, association D might consider entirely eliminating paper multiquart containers and use alternative 2 for the glass operation. However, association D may be able to increase sales through use of paper half gallons. If sales increase, an extra container size may be used with little or no increase in cost per unit.

Association E

Association E had an average volume of 14,800 quarts daily. It ranked fifth from smallest in total volume of milk packaged, with about 31 percent of its milk in glass, and about 69 percent in paper containers. In glass it packaged milk and milk products in gallons, half gallons, quarts, pints, and half pints. It packaged milk and milk products in paper half gallons, quarts, pints, and half pints.

Association E ranked fourth (going from low to high) of the eight plants in volume of milk packaged in glass. It also ranked fourth in volume of milk packaged in paper.

Association E had the highest hourly wages of the associations studied. However, it had the fourth lowest labor cost per 100 quarts of the eight plants. It was able to maintain this labor cost through a relatively high output on a quart basis per manhour. This high output kept labor cost per quart below those of several other plants. The association even accomplished this result over the disadvantage of packaging a large proportion of its milk in glass half-pints.

The analysis of association E showed that the lowest cost alternative for glass packaging and handling occurred when milk was packaged in quarts and smaller container by an estimated difference of 0.13 cent a quart. This same combination was the lowest cost in the paper operation, by an estimated difference of 0.14 cent a quart. However, these cost advantages might have been partially dissipated if volume had been lost through customer reaction to the dropping of multiquart containers.

Study of this plant and others showed that in plants with larger volume paper operations, the reduction in cost when the half-gallon containers were eliminated was much less than in plants having small volume paper operations.

For a comparison of costs when association E used various alternatives, see appendix tables 11, 12, and 13.

Association F

Association F had an average volume of 23,000 quarts daily. It packaged the sixth from the smallest volume of milk in total. The cooperative packaged about 42 percent of its milk or 10,000 quarts daily in glass and about 58 percent or 13,000 quarts daily in paper containers.

In glass it packaged milk and milk products in gallons only. This was the only association included in the study which packaged milk in glass in one size of container. It also packaged a small volume of flavored drinks in half gallon glass containers.

In paper it packaged milk and milk products in half gallons, quarts, pints, and half pints. This cooperative ranked fifth (going from low to high) in volume of milk packaged in paper. It ranked sixth in total volume of milk packaged.

Association F had the lowest total packaging and handling cost of the eight associations studied, both in glass and in paper, although two other packaged a larger total volume of milk.

The cooperative had the lowest labor cost per quart of milk packaged in glass of the eight associations. A high output per manhour on a quart basis plus the fact that nearly 99 percent of the volume was packaged in glass gallon containers greatly contributed to the low labor cost and to a very efficient overall glass operation. As noted above, a small amount of flavored drinks was packaged in half gallons.

Association F had a low labor cost as well as a low cost of packaging supplies in its paper packaging and handling operation. Concentration by this cooperative on multiquart containers both in glass and paper allowed it to maintain a high output per manhour in its filling operations.

The analysis of association F showed the advantage of a simple, one container operation as well as the advantage of a large volume operation. It pointed out some of the reasons a plant is able to sell milk in gallon and half-gallon containers at a lower price than in quart containers, if it is able to establish a large volume in the multiquart container.

For a more detailed comparison of costs of packaging and handling milk when association F used various container combinations, see appendix tables 14 and 15.

Association G

Association G had an average daily volume of 46,600 quarts of milk processed and packaged, the second highest total volume of the cooperatives studied. The cooperative packaged about 27,500 quarts a day in glass containers and about 19,100 quarts a day in paper. In glass it packaged milk and milk products in half gallons, quarts, pints, and half pints. It packaged milk and milk products in paper half-gallon twinpaks, quarts, pints, and half pints.

The cooperative packaged about 59 percent of its milk in glass and 41 percent in paper. It ranked highest in volume of products packaged in glass and second highest in volume of products in paper.

Changing glass packaging and handling operations of association G did not materially affect total glass packaging and handling cost. The savings in glass packaging and handling cost achieved by changing from packaging milk in glass half gallons, quarts, and smaller containers to only quarts and smaller containers could have been achieved only if labor had been used effectively in operations other than packaging and handling.

Association G was one of the two associations studied that packaged and sold milk in twinpak containers. This cooperative did not package milk in the single half-gallon container.

As in the case of glass containers, modifying the operations of association G did not affect paper packaging and handling cost significantly. The plant operations for packaging milk in half-gallon twinpaks, quarts, and smaller containers were nearly the same as when it packaged milk in only quarts and smaller containers. The same machines were used for packaging the twinpak cartons and the single quart cartons.

For a comparison of costs when association G used various container combinations, see appendix tables 16, 17, and 18.

Association H

Association H had an average daily volume of 58,700 quarts of milk processed and packaged, the highest of all the cooperatives included. This cooperative packaged about 13,300 quarts a day in glass containers and about 45,400 quarts a day in paper containers. In glass it packaged milk and milk products in half gallons, quarts, pints, and half pints. In paper, it also used half gallons, quarts, pints, and half pints.

The cooperative packaged about 23 percent of its milk in glass. Of the total amount in glass, 23 percent was packaged in half gallons, 16 percent in quarts and pints, and 61 percent in half-pint containers. This was a much larger percentage than for any other plant studied.

The cooperative put about 77 percent of its packaged milk in paper containers. Of the total amount in paper, 30 percent was in half-gallon and 70 percent in quart and smaller containers. The association ranked highest in volume of milk packaged in paper, with nearly 2 1/2 times the volume of the second highest plant.

Association H had the highest total glass packaging and handling cost among the plants studied. Despite the high average cost, association H had relatively low packaging and handling cost for individual container sizes. However, with such a large volume of milk packaged in half pints, the total glass packaging and handling cost per quart of milk was high.

The cost of packaging and handling milk in glass containers was the same when milk was packaged in half gallons, quarts, and small container as when milk was packaged in only quarts and smaller containers.

The analysis of glass costs of this and other plants showed that the plants with larger volume glass operations tended to be affected less by modifications than were plants with smaller volumes of milk in glass.

For a detailed comparison of costs when association H used various container combinations, see appendix tables 19, 20, and 21.

Appendix

Appendix table 1.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass containers, association A*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	0.79	0.97	0.13	0.02	0.35	0.24	2.50
2	.70	.88	.12	.01	.35	.20	2.26
3	.68	.96	.13	.01	.35	.25	2.38
4	.56	.92	.15	.01	.35	.22	2.21
5	Not applicable						

Appendix table 2.—*Comparison of cost of packaging and handling milk in selected glass containers for association A using various operating alternatives*

Item	Containers					
	Gallon		Half gallon		Quart	
	Alternative 1	Alternative 2	Alternative 1	Alternative 3	Alternative 1	Alternative 4
Units packaged daily	309	373	125	743	221	1,707
	Cents per container					
Labor	2.64	2.11	1.35	0.99	0.48	0.33
Packaging supplies	1.95	1.51	1.33	1.01	.69	.48
Operating supplies	.13	.10	.12	.09	.13	.08
Utilities	.08	.05	.03	.02	.01	.01
Building and equipment	.84	.65	.62	.45	.36	.24
General expenses	.78	.60	.60	.45	.27	.19
Total	6.42	5.02	4.05	3.01	1.94	1.33

Appendix table 3.—*Comparison of filling and packaging cost per quart under various combinations of sizes of glass and paper containers, association B*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	0.85	0.57	0.08	0.25	0.29	0.13	2.17
2	.80	.56	.08	.23	.29	.12	2.08
3	.94	.57	.08	.27	.29	.15	2.30
4	.75	.61	.09	.19	.28	.12	2.04
5	Not applicable						

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	0.52	2.30	0.07	0.11	0.25	0.03	3.28
3	Not applicable						
4	.39	1.92	.07	.10	.29	.03	2.80

Appendix table 4.—*Comparison of cost of packaging and handling milk in selected glass containers for association B using various operating alternatives*

Item	Containers					
	Gallon		Half gallon		Quart	
	Alternative 1	Alternative 2	Alternative 1	Alternative 3	Alternative 1	Alternative 4
Units packaged daily	210	252	83	504	1,359	2,367
	Cents per container					
Labor	2.83	2.72	2.59	2.09	0.72	0.66
Packaging supplies	1.39	1.39	.88	.75	.58	.53
Operating supplies	.21	.19	.14	.08	.10	.09
Utilities	1.10	1.01	.90	.71	.19	.16
Building and equipment	.65	.60	.60	.44	.31	.28
General expense	.43	.41	.43	.36	.11	.11
Total	6.61	6.32	5.54	4.43	2.01	1.83

Appendix table 5.—*Comparison of cost of packaging and handling milk in selected paper containers for association B using various operating alternatives, 1957*

Item	Containers		
	Half gallons	Quarts	
	Alternative 2	Alternative 2	Alternative 4
Units packaged daily	1,496	1,173	4,165
	Cents per container		
Labor	0.76	0.41	0.22
Packaging supplies	4.14	1.75	1.53
Operating supplies	.10	.06	.05
Utilities	.20	.11	.09
Building and equipment	.36	.26	.25
General expenses	.09	.03	.02
Total	5.65	2.62	2.16

Appendix table 6.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association C*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	Not applicable						
3	Not applicable						
4	0.58	0.45	0.10	0.05	0.16	0.06	1.40

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	0.41	1.78	0.03	0.02	0.35	0.04	2.63
3	Not applicable						
4	.33	1.72	.03	.01	.30	.03	2.42

Appendix table 7.—*Comparison of cost of packaging and handling milk in selected paper containers for association C using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 2	Alternative 2	Alternative 4
Units packaged daily	477	3,604	4,558
	Cents per container		
Labor	1.13	0.30	0.26
Packaging supplies	3.52	1.58	1.54
Operating supplies	.04	.02	.02
Utilities	.12	.02	.01
Building and equipment	1.01	.28	.27
General expenses	.10	.03	.03
Total	5.92	2.23	2.13

Appendix table 8.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association D*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	0.52	0.84	0.12	0.07	0.46	0.16	2.17
2	.54	.76	.13	.07	.46	.15	2.11
3	.51	.89	.12	.07	.46	.17	2.22
4	.56	.81	.13	.07	.46	.15	2.18
5	Not applicable						

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	0.52	2.13	0.13	0.02	0.39	0.05	3.24
2	.45	2.21	.10	.01	.30	.05	3.12
3	.52	2.03	.14	.02	.37	.05	3.13
4	.36	2.09	.10	.01	.30	.05	2.91

Appendix table 9.—*Comparison of cost of packaging and handling milk in selected glass containers for association D using various operating alternatives*

Item	Containers					
	Gallon		Half gallon		Quart	
	Alternative 1	Alternative 2	Alternative 1	Alternative 3	Alternative 1	Alternative 4
Units packaged daily	68	172	208	344	268	956
	Cents per container					
Labor	1.78	1.55	0.73	0.69	0.51	0.44
Packaging supplies	2.45	2.14	1.52	1.41	.79	.66
Operating supplies	.44	.36	.17	.16	.12	.10
Utilities	.24	.22	.10	.10	.07	.06
Building and equipment	1.30	1.15	.67	.62	.47	.39
General expense	.64	.54	.31	.30	.16	.14
Total	6.85	5.96	3.50	3.28	2.12	1.79

Appendix table 10.—*Comparison of cost of packaging and handling milk in selected paper containers for association D when using various operating alternatives*

Item	Containers					
	Twinpak		Half gallon		Quart	
	Alternative 1	Alternative 3	Alternative 1	Alternative 2	Alternative 1	Alternative 4
Units packaged daily	512	1,768	1,256	1,768	3,533	7,069
	Cents per container					
Labor	0.76	0.58	1.05	0.99	0.33	0.19
Packaging supplies	4.38	3.85	3.06	2.88	1.75	1.67
Operating supplies	.18	.14	.34	.32	.08	.07
Utilities	.02	.02	.04	.04	.01	.01
Building and equipment	.54	.49	.94	.89	.27	.26
General expenses	.10	.07	.12	.11	.05	.04
Total	5.98	5.15	5.55	5.23	2.49	2.24

Appendix table 11.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association E*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	0.56	0.71	0.13	0.07	0.22	0.19	1.88
2	.54	.69	.12	.07	.22	.18	1.82
3	.54	.71	.13	.08	.22	.19	1.87
4	.46	.67	.13	.08	.21	.14	1.69
5	Not applicable						

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	0.37	1.76	0.09	0.01	0.44	0.06	2.73
3	Not applicable						
4	.31	1.78	.08	.01	.36	.06	2.60

Appendix table 12.—*Comparison of cost of packaging and handling milk in selected glass containers for association E using various operating alternatives*

Item	Containers					
	Gallon		Half gallon		Quart	
	Alternative 1	Alternative 2	Alternative 1	Alternative 3	Alternative 1	Alternative 4
Unit packaged daily	217	309	184	618	2,316	3,552
	Cents per container					
Labor	2.35	2.20	1.43	1.13	0.42	0.37
Packaging supplies	1.73	1.64	1.18	.93	.54	.47
Operating supplies	.20	.17	.20	.17	.14	.11
Utilities	.07	.06	.07	.07	.07	.06
Building and equipment	.87	.79	.60	.49	.15	.13
General expense	.88	.79	.66	.53	.12	.10
Total	6.10	5.65	4.14	3.32	1.44	1.24

Appendix table 13.—*Comparison of cost of packaging and handling milk in selected paper containers for association E using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 2	Alternative 2	Alternative 4
Units packaged daily	3,157	2,198	8,512
	Cents per container		
Labor	0.40	0.35	0.16
Packaging supplies	2.74	1.75	1.52
Operating supplies	.18	.09	.08
Utilities	.01	.01	.01
Building and equipment	.79	.31	.28
General expense	.09	.05	.04
Total	4.21	2.56	2.09

Appendix table 14.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association F*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	Not applicable						
3	Not applicable						
4	Not applicable						
5	0.20	0.37	0.06	0.02	0.08	0.04	0.77

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	0.34	1.64	0.07	0.01	0.27	0.02	2.35
3	Not applicable						
4	.27	1.45	.09	.01	.29	.03	2.14

Appendix table 15.—*Comparison of cost of packaging and handling milk in selected paper containers for association F using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 2	Alternative 2	Alternative 4
Units packaged daily	4,997	1,322	11,316
	Cents per container		
Labor	0.47	0.49	0.17
Packaging supplies	2.96	1.66	1.29
Operating supplies	.10	.10	.07
Utilities	.01	.01	.01
Building and equipment	.49	.30	.28
General expense	.05	.04	.03
Total	4.08	2.60	1.85

Appendix table 16.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association G*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1			Not applicable				
2			Not applicable				
3	0.28	0.58	0.04	0.02	0.08	0.09	1.09
4	.24	.60	.04	.02	.08	.07	1.05
5			Not applicable				

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1			Not applicable				
2	0.22	2.35	0.02	0.01	0.40	0.04	3.04
3			Not applicable				
4	.22	2.34	.02	.01	.40	.04	3.03

Appendix table 17.—*Comparison of cost of packaging and handling milk in selected glass containers for association G using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 3	Alternative 3	Alternative 4
Units packaged daily	4,738	9,824	19,300
	Cents per container		
Labor	0.56	0.20	0.17
Packaging supplies	.68	.52	.46
Operating supplies	.04	.04	.04
Utilities	.02	.02	.02
Building and equipment	.17	.06	.05
General expenses	.17	.05	.05
Total	1.64	.89	.79

Appendix table 18.—*Comparison of cost of packaging and handling milk in selected paper containers for association G using various operating alternatives*

Item	Containers		
	Twinpaks	Quarts	
	Alternative 3	Alternative 3	Alternative 4
Units packaged daily	3,261	3,882	10,404
	Cents per container		
Labor	0.29	0.16	0.15
Packaging supplies	3.55	1.88	1.81
Operating supplies	.03	.01	.01
Utilities	.01	.01	.01
Building and equipment	.59	.29	.28
General expenses	.05	.03	.02
Total	4.52	2.38	2.28

Appendix table 19.—*Comparison of packaging and handling cost per quart under various combinations of sizes of glass and paper containers, association H*

Glass

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	Not applicable						
3	0.83	1.35	0.04	0.12	0.78	0.12	3.24
4	.82	1.37	.03	.12	.77	.12	3.23
5	Not applicable						

Paper

Alternative	Cost item						
	Labor	Packaging supplies	Operating supplies	Utilities	Building and equipment	General expense	Total
	Cents per quart						
1	Not applicable						
2	0.27	1.77	0.01	0.05	0.38	0.05	2.53
3	Not applicable						
4	.24	1.71	.01	.05	.40	.05	2.46

Appendix table 20.—*Comparison of cost of packaging and handling milk in selected glass containers for association H using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 3	Alternative 3	Alternative 4
Units packaged daily	1,517	1,866	4,900
	Cents per container		
Labor	0.81	0.46	0.39
Packaging supplies	.76	.65	.55
Operating supplies	.04	.02	.01
Utilities	.14	.07	.06
Building and equipment	.77	.43	.39
General expenses	.13	.07	.06
Total	2.65	1.70	1.46

Appendix table 21.—*Comparison of cost of packaging and handling milk in selected paper containers for association H using various operating alternatives*

Item	Containers		
	Half gallons	Quarts	
	Alternative 2	Alternative 2	Alternative 4
Units packaged daily	6,889	11,413	25,191
	Cents per container		
Labor	0.35	0.15	0.12
Packaging supplies	2.49	1.31	1.16
Operating supplies	.01	.01	.01
Utilities	.09	.04	.03
Building and equipment	.64	.30	.28
General expenses	.08	.03	.03
Total	3.66	1.84	1.63

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